

WHAT IS CLAIMED IS:

- 1 1. In a switch having N_{in} input ports applied to K_{in} input
2 shared blocks, a central switching fabric, and N_{out}
3 output ports provided from K_{out} output shared blocks, a
4 method for scheduling packets queued at the input
5 shared blocks for application to the output ports, the
6 method comprising steps of:
7 a) providing, for each of the input shared blocks, an
8 indication of a number of links reserved by the input
9 shared block to each of the output shared blocks;
10 b) providing each of the input shared blocks with a
11 token, each token corresponding to an output shared
12 block and including a value indicating a number of
13 links available to the associated output shared block;
14 c) if it is determined that an input shared block
15 needs links to an output shared block associated with
16 a token held by the input shared block, then
17 i) reserving links, to the extent available as
18 indicated by the token, to the output shared
19 block
20 ii) updating the value indicating the number of
21 links available to the associated output shared
22 block, and
23 iii) updating the value of the indication of a
24 number of links reserved by the input shared
25 block to the associated output shared block.
- 1 2. The method of claim 1 further comprising a step of
2 d) passing the token to a next input shared block at
3 the end of a reservation time slot.

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1 3. The method of claim 2 wherein a cell slot includes at
2 least one reservation slot and further comprising a
3 step of:
4 d) delivering cells to the central switch fabric
5 based on their currently reserved links at the end of
6 each cell slot.

1 4. The method of claim 3 further comprising a step of:
2 e) destroying the tokens at the end of each cell
3 slot; and
4 f) generating new tokens at each input shared block
5 at the end of each cell slot.

1 5. In a switch having N_{in} input ports applied to K_{in} input
2 shared blocks, a central switching fabric, and N_{out} output
3 ports provided from K_{out} output shared blocks, a method for
4 scheduling packets queued at the input shared blocks for
5 application to the output ports, the method comprising
6 steps of:
7 a) for each of the input shared blocks, providing a
8 request token associated with one of the output shared
9 blocks, each of the request tokens including an
10 indication based on a number of requested links for
11 the output shared block with which it is associated;
12 b) for each of the input shared blocks, providing a
13 release token associated with one of the output shared
14 blocks, each of the release tokens including an
15 indication based on a number of released links for the
16 output shared block with which it is associated;
17 c) for each of one or more reservation time slots
18 within a cell time slot,

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19      i) accepting, by an input shared block, a
20      request token from another input shared block,
21      ii) determining whether a virtual output queue
22      of the input shared block associated with the
23      output shared block with which the request token
24      is associated, is heavily occupied,
25      iii) if it is determined that the virtual output
26      queue of the input shared block associated with
27      the output shared block with which the request
28      token is associated is heavily occupied, then
29          A) requesting at least one extra link to
30          the output shared block associated with the
31          accepted request token,
32      iv) determining whether the virtual output queue
33      of the input shared block associated with the
34      output shared block with which the request token
35      is associated, is lightly occupied,
36      v) if it is determined that the virtual output
37      queue of the input shared block associated with
38      the output shared block with which the request
39      token is associated is lightly occupied, then
40          A) releasing at least one link to the
41          output shared block associated with the
42          accepted request token if it is indicated
43          that a number of requested links for the
44          output shared block is greater than zero,
45      vi) if it is determined that the virtual output
46      queue of the input shared block associated with
47      the output shared block with which the request
48      token is associated is not lightly occupied, then
49          A) releasing at least one link to the
50          output shared block associated with the

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51 accepted request token if the input shared
52 block reserved more than a predetermined
53 number of links and if it is indicated that
54 a number of requested links for the output
55 shared block is greater than zero,
56 vii) accepting, by the input shared block, a
57 release token from another input shared block;
58 viii) determining whether or not the input
59 shared block can take a link to the output shared
60 block associated with the release token,
61 ix) if it is determined that the input shared
62 block can take a link to the output shared block
63 associated with the release token, then taking a
64 link from the release token.

1 6. The method of claim 5 wherein the step of determining
2 whether a virtual output queue of the input shared block
3 associated with the output shared block with which the
4 request token is associated, is heavily occupied, is based
5 on a comparison with a threshold value.

1 7. The method of claim 5 wherein the step of requesting an
2 extra link to the output shared block associated with the
3 accepted request token, is effected by setting a request
4 indicator corresponding to the input shared block and the
5 output shared block, and incrementing the indication based
6 on the number of links to the output shared block
7 requested.

1 8. The method of claim 5 wherein the step of determining
2 whether the virtual output queue of the input shared block
3 associated with the output shared block with which the

4 request token is associated, is lightly occupied, is based
5 on a comparison with a threshold value.

1 9. The method of claim 5 wherein the step of releasing a
2 link to the output shared block associated with the
3 accepted request token is effected by decreasing the
4 indication based on the number of links to the output
5 shared block released.

1 10. The method of claim 5 wherein the step of determining
2 whether or not the input shared block can take a link to
3 the output shared block associated with the release token,
4 is based on a number of all reserved links by the input
5 shared block and an indication of whether or not the input
6 shared block had requested a link to the output shared
7 block.

1 11. The method of claim 5 further comprising a step of:
2 d) delivering, by each of the input shared blocks,
3 cells to the central switch fabric based on current
4 indications of a number of link reservations to each
5 of the output shared blocks, at the end of a cell time
6 slot.

1 12. In a switch having N_{in} input ports applied to K_{in} input
2 shared blocks, a central switching fabric, and N_{out} output
3 ports provided from K_{out} output shared blocks, a method for
4 scheduling packets queued at the input shared blocks for
5 application to the output ports, the method comprising
6 steps of:

7 a) for each of the input shared blocks, providing a
8 request token associated with one of the output shared

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9 blocks, each of the request tokens including an
10 indication based on a number of requested links for
11 the output shared block with which it is associated;
12 b) for each of the input shared blocks, providing a
13 release token associated with one of the output shared
14 blocks, each of the release tokens including an
15 indication based on a number of released links for the
16 output shared block with which it is associated;
17 c) for each of one or more reservation time slots
18 within a cell time slot,
19 i) accepting, by an input shared block, a
20 request token from an another input shared block,
21 ii) determining whether a virtual output queue
22 of the input shared block associated with the
23 output shared block with which the request token
24 is associated, is heavily occupied,
25 iii) if it is determined that the virtual output
26 queue of the input shared block associated with
27 the output shared block with which the request
28 token is associated is heavily occupied, then
29 A) requesting at least one extra link to
30 the output shared block associated with the
31 accepted request token,
32 iv) determining whether the virtual output queue
33 of the input shared block associated with the
34 output shared block with which the request token
35 is associated, is lightly occupied,
36 v) if it is determined that the virtual output
37 queue of the input shared block associated with
38 the output shared block with which the request
39 token is associated is lightly occupied, then

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40 A) releasing at least one link to the
41 output shared block associated with the
42 accepted request token if it is indicated
43 that a number of requested links for the
44 output shared block is greater than zero,
45 vi) if it is determined that the virtual output
46 queue of the input shared block associated with
47 the output shared block with which the request
48 token is associated is not lightly occupied, then
49 A) releasing at least one link to the
50 output shared block associated with the
51 accepted request token if the input shared
52 block reserved more than a predetermined
53 number of links,
54 vii) accepting, by the input shared block, a
55 release token from another input shared block,
56 viii) determining whether to release at least
57 one link to the output shared block with which
58 the accepted release token is associated based on
59 a queue occupancy, a number of links reserved,
60 and a predetermined number of links
61 ix) if it has been determined to release a link
62 to the output shared block with which the
63 accepted release token is associated, releasing a
64 link,
65 x) determining whether or not to take at least
66 one released link to the output shared block with
67 which the accepted release token is associated
68 based on queue occupancy, a number of links
69 reserved, and a number of links between the input
70 shared block and the central switch fabric, and

71 xi) if it is determined to take at least one
72 released link to the output shared block with
73 which the accepted release token is associated,
74 taking at least one link.

1 13. The method of claim 12 wherein the step of determining
2 whether a virtual output queue of the input shared block
3 associated with the output shared block with which the
4 request token is associated, is heavily occupied, is based
5 on a comparison with a threshold value.

1 14. The method of claim 12 wherein the step of requesting
2 at least one extra link to the output shared block
3 associated with the accepted request token, is effected by
4 setting a request indicator corresponding to the input
5 shared block and the output shared block, and incrementing
6 the indication based on the number of links to the output
7 shared block requested.

1 15. The method of claim 12 wherein the step of determining
2 whether the virtual output queue of the input shared block
3 associated with the output shared block with which the
4 request token is associated, is lightly occupied, is based
5 on a comparison with a threshold value.

1 16. The method of claim 12 wherein the step of releasing
2 at least one link to the output shared block associated
3 with the accepted request token is effected by decreasing
4 the indication based on the number of links to the output
5 shared block released.

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1 17. The method of claim 12 wherein the step of determining
2 whether or not the input shared block can take at least one
3 link to the output shared block associated with the release
4 token, is based on a queue occupancy of a virtual output
5 queue, and a number of all reserved links by the input
6 shared block and an indication of whether or not the input
7 shared block had requested at least one link to the output
8 shared block if it is indicated that a number of released
9 links for the output shared block is greater than zero.

1 18. The method of claim 12 further comprising a step of:
2 d) delivering, by each of the input shared blocks,
3 cells to the central switch fabric base based on
4 current indications of a number of link reservations
5 to each of the output shared blocks, at the end of a
6 cell time slot.

1 19. A switch for switching packets arriving at a number of
2 input ports to an appropriate one of a number of output
3 ports, the switch comprising:

- 4 a) a central switching fabric;
- 5 b) output shared blocks, each coupled with at least
6 one output port;
- 7 c) links between the central switch fabric and each
8 of the output shared blocks
- 9 d) input shared blocks, each
 - 10 i) coupled with at least one input port,
 - 11 ii) having virtual output queues, each of the
12 virtual output queues corresponding to one or
13 more output ports,
 - 14 iii) storing

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- 15 A) an indication of whether at least one
16 links to each of the output shared blocks
17 has been requested,
18 B) an indication based on a number of links
19 to each of the output shared blocks
20 released, and
21 C) an indication based on a number of links
22 reserved to each of the output shared
23 blocks;
24 e) request tokens, each associated with a particular
25 one of the output shared blocks and each indicating a
26 number of requests for links to the associated one of
27 the output shared blocks;
28 f) release tokens, each associated with a particular
29 one of the output shared blocks and each indicating a
30 number of released links to the associated one of the
31 output shared blocks; and
32 g) links between the central switch fabric and each
33 of the input shared blocks.

- 1 20. The switch of claim 19 wherein each of the input
2 shared blocks holds at least one of the request tokens and
3 at least one of the release tokens during a reservation
4 time slot.

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